



WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005CO117B

Title: Occurrence and Fate of Organic Wastewater Contaminants in Onsite Wastewater Systems and Implications for Water Quality Management

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Abstract

Occurrence and Fate of Organic Wastewater Contaminants in Wastewater Systems and Implications for Water Quality Management

Problem

The Colorado Front Range and Rocky Mountain region is a relatively arid environment that has experienced significant human population growth and development in the last decade, particularly in the suburban fringe and mountain resort settings. In these areas, wastewater management is commonly achieved by Onsite Wastewater Systems (OWS). These small onsite systems, like their municipal counterparts, can, and must, be designed, installed, operated, and managed to protect human health and environmental quality. In Colorado there are over 600,000 OWS in operation, serving about 25% of the state's population, and 7,000 to 10,000 new systems installed every year. These systems process over 100 billion liters of wastewater each year that is then discharged to the environment. There is almost no information regarding the occurrence and fate of Organic Wastewater Contaminants (OWCs) in these systems and the potential for adverse impacts of discharge into receiving waters including impacts on ecosystems and human health.

Objectives

The research proposed will provide new information on (1) the occurrence and magnitude of pharmaceuticals, consumer products, and other OWCs in onsite wastewater system effluents from different types of sources (e.g., residential, commercial, institutional) and (2) the removal efficiencies that can be expected for commonly occurring OWCs during wastewater effluent percolation through unsaturated soil prior to groundwater or surface water recharge.

Methods

Samples will be collected and analyzed from controlled laboratory and field studies. At the Mines Park Water Reclamation Site located on the CSM campus (www.mines.edu/research/smallq/ffield.html), wastewater from a multifamily housing complex is intercepted and managed onsite using pilot-scale unit operations and in-ground test cells with associated sensors and monitoring devices. A tracer test will compare the movement of a pharmaceutical surrogate with that of a conservative tracer (bromide) after application to the infiltrative surface of each test cell. Samples will be collected from in-situ lysimeters located 2, 4, and 8 feet below the infiltrative surface and analyzed for both tracers and wastewater parameters. To identify the fate of OWCs, samples will also be collected from the wastewater effluent of each of the pretreatment unit processes (septic tank, textile filter, and membrane bioreactor) and from the soil subsurface at 2, 4, and 8 feet below the infiltrative surface where the wastewater is applied. These samples will be analyzed for the conventional wastewater parameters listed above and for a suite of OWCs.

Monitoring will be completed following established protocols and methodologies (APHA 1998, Barber et al. 2000, Brown et al. 1999). To preserve the sample integrity, proper sample handling procedures will be employed from the time of sample collection through sample analysis during all monitoring tasks (USGS 1999). Proper field monitoring apparatus for water, wastewater, and soil/sediment sampling and water quality measurements are available through CSM facilities. Conventional pollutants will be analyzed in the field and CSM laboratories equipped with instruments for water and wastewater quality measurements using standard methods (APHA 1998). Bench- and pilot-scale experimentation will also be carried out at CSM facilities. OWCs will be analyzed by the student using two methods developed by Dr. Larry Barber and others in the USGS NRP. An acetyl chloride/propanol derivatization and a continuous liquid-liquid extraction will be executed before analysis by state-of-the-art gas chromatography/mass spectroscopy instrumentation. The methods will identify a suite of over 50 OWCs, including caffeine, bisphenol A, 4-nonylphenol and its ethoxy and carboxylate derivatives.